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Analysis of income and risks of the vaname shrimp business in Bratasena ponds, Tulang Bawang, Lampung

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ABSTRACT

The research method used is field surveys and structured interviews with shrimp farmers. The collected data were analyzed using both quantitative and qualitative approaches. The analysis results indicate that income from vannamei shrimp business tends to be stable but is influenced by external factors such as price fluctuations and market conditions. On the other hand, risks such as shrimp diseases, climate change, and government regulations also affect the sustainability of this business. This research provides important insights for stakeholders in managing risks and enhancing the sustainability of vannamei shrimp business.

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INTRODUCTION

The growth of the fisheries industry, particularly in the cultivation of vannamei shrimp, has become a vital economic pillar for many countries, including Indonesia (Emerenciano et al., 2022). In recent decades, the fisheries industry has experienced rapid growth and has become one of the main sectors contributing significantly to the country's Gross Domestic Product (GDP) (Tanjung et al., 2021). Vannamei shrimp cultivation, in particular, has been a primary focus in efforts to diversify the economy and increase farmers' income in coastal and inland areas (Sivaraman et al., 2019). This growth has not only created new job opportunities but has also increased rural community income and reduced pressure on existing natural resources (Nguyen et al., 2019). Furthermore, vannamei shrimp cultivation also offers significant export opportunities, generating foreign exchange for the country and strengthening its position in international trade (Singh et al., 2021). Various studies underscore the significant contribution of vannamei shrimp efforts to the economy and reveal the substantial income potential in various regions of the country (Khan et al., 2023).

For example, a study conducted by (Syamsuri et al., 2023) in Seuwwa Village, Pakue District, North Kolaka Regency, Southeast Sulawesi Province, illustrates the profitability of vannamei shrimp cultivation. This study revealed compelling evidence of the economic benefits derived from such ventures. The findings unveiled a substantial profit margin, with returns amounting to Rp 17,073,000 alongside operational gains totaling Rp 17,193,000. These figures not

only underscore the financial rewards of engaging in vannamei shrimp farming but also highlight its potential to significantly boost local economies. Furthermore, the research conducted by (Makalingga et al., 2019) in Purworejo Regency provides further testament to the financial viability of this industry. Their study reported an impressive profit of Rp 1,415,992,500, affirming the lucrative nature of vannamei shrimp farming. Moreover, the documented income and net profit figures stand as robust indicators of the sustainability and long-term viability of this thriving enterprise.

Although the vannamei shrimp industry holds promise in terms of profit potential, it cannot be overlooked that this industry carries risks that need to be carefully considered, especially in market dynamics. A study by (Adhawati et al., 2020) focusing on market risks related to input and output in vannamei shrimp hatcheries highlights significant concerns. In this research, feed prices and broodstock prices were identified as the primary input market risks, each with probabilities of 36.53% and 25.93%, respectively. On the other hand, the prices and sales of fish seeds also pose significant production market risks, with probabilities of 44.74% and 78.52%, respectively. Therefore, it is essential for stakeholders in the vannamei shrimp industry to understand and manage these risks to sustain and thrive in fluctuating markets (Liufeto et al., 2023).

One of the vannamei shrimp cultivation sites under scrutiny in this research is Tambak Brantasena Adiwarna on tracks 34-35. Despite its considerable potential as a center for vannamei shrimp cultivation, Tambak Brantasena Adiwarna on tracks 34-35 still faces several issues that could disrupt productivity and business sustainability. Complex factors such as unpredictable market price fluctuations, shrimp disease outbreaks leading to significant losses in a short time, climate change affecting pond environmental conditions, and government policies that often fluctuate in fisheries sector regulations, all pose challenges for shrimp pond managers ((Irwandi et al., 2023; Joffre et al., 2018). The uncertainties associated with these factors not only disrupt day-to-day operations but also directly impact the local economy and the welfare of communities dependent on shrimp cultivation industries (Hapsari & Nurhayati, 2023; Mauladani et al., 2020). Moreover, the intensifying competition in the global market further pressures pond managers to continually enhance efficiency and innovation in their operations (Boyd et al., 2020).

Previous research on pond farming in Indonesia has extensively explored the factors influencing the income of vannamei shrimp farmers and the level of risk they face (Irwandi et al., 2023; Joffre et al., 2018; Lestariadi et al., 2018). However, there is still a gap in understanding how specific factors related to particular locations affect income and risk in the context of ponds in specific regions, such as Tambak Brantasena in Tulang Bawang, Lampung. Location Bratasena was chosen for this research because it has conducive environmental conditions for vannamei shrimp cultivation, such as water quality, temperature, and supporting infrastructure including access to markets and distribution facilities. Additionally, Bratasena has a long tradition in fisheries cultivation and a well-organized shrimp farming community, providing a competitive advantage compared to other locations (Rachmawati et al., 2021). Understanding income dynamics and risks in Bratasena's ponds is crucial because each location has unique environmental and economic conditions. Specialized analysis in Bratasena helps identify specific challenges and opportunities faced by shrimp farmers there, which is valuable for developing effective risk management strategies as well as increasing productivity and sustainability in shrimp cultivation efforts. The findings of this research theoretically provide empirical data that enriches the economic understanding of the feasibility of shrimp farming and risk factors, thus strengthening economic models related to risk management, investment decisions, and profitability in the aquaculture sector. Practically, it can assist pond entrepreneurs in adopting better and more efficient management practices, and serve as a basis for policymakers to support the sustainability of shrimp farming through infrastructure improvements and financial assistance. A better

understanding of income and risks in Bratasena's tambak enables more informative strategic steps for both parties.

RESEARCH METHOD

This research was conducted in Brantasena Adiwarna Village, Dente Telandas District, Tulang Bawang Regency, with a focus on vannamei shrimp farmers. The population involved consisted of 35 shrimp farmers. Sampling was conducted using a saturated sampling method, where all members of the population were included as samples. The data used comprised primary data obtained through interviews and direct observations. Example interview with respondents: 'What are the factors that influence the income of your vannamei shrimp business?' As well as secondary data obtained from relevant institutions such as the Central Bureau of Statistics and PT Central Pertiwi Bratasena. The analysis methods employed included income analysis, production risk analysis, price risk analysis, and income risk analysis. The explanations are as follows:

a. Analysis of Vaname shrimp farming income refers to Shinta (2011). The income analysis formulated as follows:

$$Pd = TR - TC \quad (1)$$

$$TR = Y \cdot Py \quad (2)$$

$$TC = FC + VC \quad (3)$$

Pd = Income (Rp/Planting season)
TR = Revenue (Rp/Planting season)
TC = Total cost (Rp/Planting season)
FC = Fixed cost (Rp/Planting season)
VC = Variable cost (Rp/Planting season)
Y = Shrimp production (Kg/Planting season)
Py = Price (Rp/Kg)

b. Analysis of production, price, and income risks in Vaname shrimp farming based on production, price, and income data from the previous planting season. The risk analysis formulated according to Kadarsan (1995) is as follows:

$$V\alpha = \sqrt{\frac{\sum(Q-Qi)^2}{n-1}} \quad (4)$$

$$CV = \frac{V\alpha}{Q1} \quad (5)$$

$$L = Qi\text{-}2\ V\alpha \quad (6)$$

Explanation:
Vα = standard deviation
Q = production (kg/ha), price (Rp/kg), income (Rp/kg) of shrimp pond farming.
Qi = average production (kg/ha), average price (Rp/kg), average income (Rp/kg) of shrimp pond farming.
n = sample size
CV = Coefficient of Variation
L = lower limit of the highest yield
Correlation between the lower limit values of production, price, and income (L) with the coefficient of variation (CV). When CV ≤ 0.5, then the value of L ≥ 0, while if CV > 0.5, the value of L < 0. This indicates that if CV ≤ 0.5, farmers reduce the risk in Vaname shrimp farming, whereas if CV > 0.5, farmers face higher risks in Vaname shrimp farming.

RESULTS AND DISCUSSIONS

Understanding the cost structure is crucial for Vaname shrimp farming at Brantasena Pond, Tulang Bawang, Lampung. In this context, the costs involved encompass various aspects vital for the operational sustainability of the pond. Firstly, depreciation costs of equipment are a primary consideration, given that the continuous functioning of pond equipment such as nets, water pumps, and other tools is key to daily operations. Furthermore, acquiring shrimp seeds, known as "benur," requires a significant allocation of funds. Additionally, costs for acquiring fertilizers, medicines, and feed must be seriously considered as they directly relate to shrimp productivity and health. Equally important are labor costs, including wages for individuals involved in daily activities such as pond cleaning, feeding, and maintenance. Lastly, but not less important, are additional costs categorized as "miscellaneous," including transportation expenses, equipment maintenance, and administration. A deep understanding of this cost structure provides valuable insights for pond farmers to efficiently manage their finances and plan appropriate pond management strategies. The detailed breakdown of Vaname shrimp farming expenses in that area is provided in the following Table 1:

Table 1. Expenditure of Vannamei Shrimp Farming Business

No	Type of Expenditure	Cost (IDR/Planting Season/Ha)
1	Depreciation of Equipment	290.375
2	Juvenile Shrimp	3.340.000
3	Fertilizer, Medicine & Feed	11.610.000
4	Labor Costs	2.205.000
5	Other Expenses	1.776.000
Total Cost		**19.221.375.**

Based on Table 1 above, it can be observed that the depreciation cost of vannamei shrimp farming equipment is Rp 290,375 per planting season per hectare, covering the reduction in value of various vital tools in day-to-day operations. This includes water pumps that maintain water quality and circulation in the cultivation ponds, pond infrastructure such as walls and lining layers, and aeration systems that provide sufficient oxygen for the shrimp. Additionally, investments in irrigation systems, drainage, and measurement equipment such as pH meters and thermometers are also included in this depreciation cost. Handling and processing equipment for shrimp before and after harvest are also part of this initial investment. By carefully considering the depreciation cost of this equipment in the total production cost, farmers can set the right selling price to cover not only production costs but also equipment investments (Wiranata et al., 2022). This also allows for better planning for rejuvenation or replacement of equipment in the future, which is crucial to maintain productivity and efficiency in vannamei shrimp farming.

In the practice of vannamei shrimp farming, juveniles are one of the most significant cost components. The cost of Rp 3,340,000 per planting season per hectare allocated for juveniles reflects the importance of the initial stage in the shrimp farming cycle. Juveniles, or shrimp larvae, represent the first stage in the cultivation process, where young shrimp are purchased and reared in cultivation ponds until they reach a size ready for harvest (Berk, 2023). The quality and quantity of juveniles purchased directly affect the overall productivity and profitability of the vannamei shrimp farming operation (Kim et al., 2020). The process of selecting good quality juveniles is a key step in ensuring the success of shrimp production. Healthy and high-quality juveniles will have high survival rates and rapid growth, minimizing the risk of losses and maximizing harvest yields. Therefore, farmers often make significant investments in obtaining high-quality juveniles from reliable sources. The substantial cost for juveniles also reflects the challenges associated with

nurturing and managing juveniles during the early growth period (Kim et al., 2020). Factors such as water quality, temperature, feed availability, and disease control must be carefully monitored to ensure optimal conditions for juvenile growth. The efforts required to care for juveniles add complexity and operational costs to the early stage of vannamei shrimp cultivation.

Expenditure on fertilizer, medicine, and feed is one of the largest components in the total production cost of vannamei shrimp farming, reaching a value of Rp 11,610,000 per planting season per hectare. This component underscores the importance of quality care and maintenance in ensuring the health and optimal growth of the shrimp population during the cultivation period. Fertilizers are one of the primary elements in providing the necessary nutrients for the growth of microorganisms in the cultivation ponds. These nutrients are crucial as the microorganisms serve as a natural food source for the shrimp. Selecting and applying the right fertilizers are key to ensuring an adequate supply of nutrients for these microorganisms, thereby enabling healthy growth of the shrimp population (Green, 2015). Additionally, the use of medications is an important preventive and curative step in maintaining shrimp health. These medications are used to control and prevent the spread of infectious diseases among the shrimp. Regular monitoring of shrimp health conditions and the use of medications in accordance with good practice guidelines are essential in reducing the risk of losses due to disease.

The cost for labor amounting to Rp 2,205,000 per planting season per hectare is a significant investment in running vannamei shrimp farming operations. Labor plays a crucial role in performing various tasks required in the daily cycle of farming, including pond maintenance, feeding, monitoring water quality, and supervising the health and condition of the shrimp. The skills and experience of labor in handling shrimp and understanding their needs are key factors in ensuring production success (Belle et al., 2022). Labor costs also encompass aspects such as equipment management and operation, pond infrastructure maintenance, and other daily activities necessary to maintain an optimal environment for shrimp growth. Additionally, ongoing training and education for labor are also part of this investment, ensuring that they have the latest knowledge and skills in good farming practices.

Meanwhile, other expenses totaling Rp 1,776,000 per planting season per hectare encompass various administrative and operational aspects that support the smooth running of daily operations. This may include administrative costs such as permits, insurance, and other administrative expenses related to business management. Additionally, transportation costs for the delivery of materials, equipment, and products may also fall under this category. Other expenses may also include minor costs associated with the maintenance and repair of infrastructure, the purchase of equipment and supplies, and various other needs that arise in daily operations. Although sometimes considered minor details, efficient management of these costs is crucial to maintaining the smoothness and effectiveness of overall operations (Nguyen et al., 2019).

Therefore, expenditures on labor and other miscellaneous costs in vannamei shrimp farming are not just expenses but crucial investments in maintaining productivity, quality, and sustainability of the farming venture. By carefully considering and efficiently managing both of these cost components, farmers can ensure that their farming operations run smoothly and yield optimal results.

Table 2. Revenue of Vannamei Shrimp Farming Business

No	Assessment	Unit	Value
1	Production	Kg/Ha/Planting Season	675
2	Price	Rp/Kg	56.300
3	Receipts	Rp/Ha/Planting Season	38.002.500
4	Total Costs	Rp/Ha/Planting Season	19.221.375
5	Revenue	Rp/Ha/Planting Season	18.781.125

Table 2 shows that in Vannamei shrimp farming, land productivity is a key factor in achieving optimal income. With shrimp production reaching 675 kg per hectare per planting season, farmers need to focus on practices that can enhance harvest yields. This includes monitoring water quality, efficient feed management, and good sanitation control in cultivation ponds (Goh et al., 2023). Additionally, controlling production costs is also a top priority. Farmers can improve cost management through the selection of efficient feeds, the use of appropriate technology, and wise resource management. By optimizing production costs, farmers can increase their profit margins. Product diversification can also be an effective strategy in adding value and reducing post-harvest risks. In addition to selling fresh shrimp, farmers can consider derivative products such as frozen shrimp or processed shrimp. Improving product quality is also an important factor in attracting market interest and obtaining better prices (Hoe & Mansori, 2018). By considering these practices holistically, farmers can enhance productivity, efficiency, and income in Vannamei shrimp farming.

The selling price of shrimp per kilogram often experiences fluctuations that can significantly affect farmers' income. In 2023, the price of vannamei shrimp ranged around Rp56,300 per kilogram. It is important to remember that this price can change due to various external factors such as market demand, weather conditions, or government policy changes. Therefore, farmers need to monitor market price changes regularly and make strategic adjustments in their business management. Strategies to cope with price fluctuations include product diversification, flexible pricing, and careful financial planning. Product diversification can help reduce risks from price fluctuations by offering various types of shrimp products or other derivative products. Flexible pricing allows farmers to adjust their selling prices according to current market conditions. Additionally, careful financial planning can help manage financial risks and maintain a balance between income and production costs.

With a production of 675 kg per hectare per planting season and a selling price of Rp56,300 per kilogram, the total revenue from vannamei shrimp sales reaches Rp38,002,500. An analysis of this data illustrates important aspects of the Vannamei shrimp farming business. Firstly, the high production figure indicates a good level of productivity in the cultivation, which can serve as an indicator of the efficiency and success of the cultivation techniques used. Secondly, a stable or high selling price demonstrates a good market value for vannamei shrimp products. However, the analysis should also take into account risks associated with this business, such as disease risks, market price fluctuations, and other environmental factors. Additionally, this data can be used as a basis for evaluating the potential for developing vannamei shrimp farming businesses, considering strategies to improve productivity and profitability, as well as managing existing risks.

The total cost incurred to produce vannamei shrimp per hectare per planting season amounting to Rp19,221,375 is the sum of various cost components involved in the vannamei shrimp farming process. These costs encompass various operational and administrative aspects necessary to maintain production rates and shrimp quality. The net income of Rp18,781,125 per hectare per planting season reflects the result of farmers' overall efforts in producing and marketing their vannamei shrimp. Although in some cases, this net income may appear lower than the total expenses incurred, it reflects the reality of business sometimes not always being profitable. However, this net income remains an indicator of success and provides encouragement for farmers to continually improve efficiency and seek opportunities to enhance their profit margins.

Table3. Calculation of Risks in Vannamei Shrimp Farming Business

Assessment	Production Risk (Kg/Ha)	Risk price (Rp)	Income Risk (Rp)
Mean (Qi)	675	56.300	18.781.125
Standard Deviation (V)	112.5	17.509	5.526.854
Coefficient of Variation (CV)	16.67	31.14	29.45

Lower Bound (L)	450	21,282	7,727,417

Table 3 on production risk in Vannamei shrimp farming indicates that although the average production reaches 675 Kg per hectare, the standard deviation of 112.5 Kg shows significant potential fluctuation from this average value. Some examples of production risks that may occur include deterioration in water quality affecting shrimp growth, disease outbreaks causing mass mortality in shrimp populations, environmental disruptions such as floods or droughts, and market instability affecting shrimp selling prices (Bernzen et al., 2023). The relatively low coefficient of variation of 16.67% suggests that while production fluctuations exist, the level of variation is not considered extreme. However, the lower bound of production set at 450 Kg per hectare indicates that the risk of production falling below this threshold remains significant. Therefore, risk management is key in addressing these challenges, with possible strategies including portfolio diversification, implementation of more advanced technology, or adoption of more efficient farming practices. By understanding the production risks associated with Vannamei shrimp farming and taking appropriate preventive measures, producers can enhance their resilience to market fluctuations and environmental factors, thus improving the financial security and long-term sustainability of their operations.

The analysis of Vannamei shrimp price risk reveals that the average price is Rp 56,300. This represents the median value within the observed price range over a certain period. The standard deviation, which measures the statistical spread of data points from the mean, is Rp 17,509. This indicates that shrimp prices can vary relatively widely from the average value. The coefficient of variation, calculated as the percentage of the standard deviation compared to the mean, is 31.14%. This indicates a relatively high level of variation in Vannamei shrimp prices. A higher coefficient of variation implies greater relative variation in prices, indicating higher risks associated with price fluctuations (Tobing et al., 2021). The lower bound (L) is the lowest possible value for Vannamei shrimp prices, which is Rp 21,282. This provides an overview of the lowest price level that can be anticipated, which is important information for financial planning and risk management. If prices fall below this lower bound, it can lead to a significant decrease in income for Vannamei shrimp producers. Therefore, with the presented mean price, standard deviation, coefficient of variation, and lower bound, it can be understood that price risk is an important aspect that needs to be carefully managed in Vannamei shrimp farming. Effective risk management includes strategies such as product or market diversification, futures contracts, or hedging to protect income from adverse price fluctuations (Asaad, Andi Indra Jaya, 2019).

Income risk in Vannamei shrimp farming is the result of multiplying production risk and price risk. The recorded average income of Rp 18,781,125 provides an overview of the expected income from the business. However, the standard deviation reaching Rp 5,526,854 indicates significant variation in income from this average value. This variation could be caused by fluctuations in shrimp production and changes in its selling price in the market. Examples of income risks that may occur include sharp declines in shrimp selling prices due to increased global supply or unforeseen changes in consumer preferences (Irwandi et al., 2023). This can result in income far below the expected average. The coefficient of variation of 29.45% highlights the relative level of variation in income, indicating a fairly high level of risk associated with income fluctuations in the operation. The presence of a lower bound of income of Rp 7,727,417 confirms that there is potential for the lowest income to occur, especially in situations where production and prices are at their lowest levels. Therefore, effective risk management needs to be implemented to address this income risk, including diversification strategies, hedging, or careful market monitoring to reduce the impact of production and price fluctuations on Vannamei shrimp farming income (Tobing et al., 2021). Thus, understanding and carefully handling this income risk will be key to maintaining the sustainability and financial success of Vannamei shrimp farming.

CONCLUSION

This research provides a comprehensive overview of the risks of production, prices, and income in Vannamei shrimp farming. Production risk analysis indicates the potential for significant fluctuations in average production, despite relatively low standard deviation values. Production risks include factors such as water quality deterioration, disease outbreaks, environmental disturbances, and market instability. Price risk, with significant standard deviation, shows high price variations that can significantly impact income. Income risk, resulting from the interaction of production and price risks, highlights the potential for income decline below the established threshold. Proper risk management is necessary to mitigate the negative impacts of production and price fluctuations on income, ensuring the sustainability and financial success of Vannamei shrimp farming.

The results of this study can contribute to the improvement of the welfare of the local community and the sustainability of the regional economy in several ways. Increasing farmers' income by implementing more efficient and productive practices can boost their earnings. The growth of the shrimp farming industry can also create new job opportunities in the area, both directly in the farms and in related sectors such as feed, distribution, and sales. Additionally, training and education suggested based on the study findings can enhance the skills of farmers and farm workers, improving production quality and competitiveness. Higher and more stable income from the shrimp farming sector can also strengthen the local economy, enhance the purchasing power of the community, and drive the development of other economic sectors.

Income and risk analysis depict theoretical implications related to agricultural economic principles and risk management. Production risk reflects the fundamental concepts of agricultural production theory, highlighting the relationship between production inputs and shrimp harvest yields, as well as the fluctuations that may occur due to environmental and cultivation factors. Price risk mirrors market principles and economic pricing, where shrimp price fluctuations are reflected by the interaction of supply and demand in the market. The concept of hedging from financial theory is also relevant, with the use of financial instruments to protect income from price fluctuations. Finally, the integrated risk management approach emphasizes the importance of holistic strategies to manage production and price risks simultaneously, enabling Vannamei shrimp farmers to develop comprehensive strategies in facing uncertainty. Thus, understanding and applying these theories play a key role in enhancing the sustainability and operational success of Vannamei shrimp farming.

The practical implications of risk analysis in Vannamei shrimp farming highlight several crucial steps for effectively managing risks. Production diversification, through cultivating various types of shrimp or additional farming such as seaweed cultivation, can reduce the overall risk of loss from a single income source. The use of futures contracts or options allows farmers to protect the selling price of their shrimp from market fluctuations. Investing in advanced technology, such as environmental monitoring systems or efficient water processing technology, can help mitigate production risks due to changes in environmental conditions. Careful market analysis helps farmers understand price trends and factors influencing shrimp price movements. Wise financial management, including budget planning and sufficient financial reserves, is essential for addressing income declines that may be caused by production and price risks. By implementing these strategies, Vannamei shrimp farmers can enhance their resilience to market fluctuations and environmental factors, while minimizing their negative impact on their overall operations.

This research reveals several limitations that need to be considered, as well as directions for further research in Vannamei shrimp farming risk management. Firstly, the risk analysis conducted is limited to specific factors such as production fluctuations, price fluctuations, and income risks, potentially leaving unidentified other risk factors. Secondly, limitations in historical data can affect the accuracy of risk analysis, necessitating periodic data updates and validation.

Additionally, there is currently no comprehensive risk management model that considers various risk factors and the effectiveness of proposed risk management strategies. Therefore, further research could broaden the scope of analysis by considering additional risk factors, developing a more holistic risk management model, and conducting case studies and quantitative analyses to evaluate risk management strategies more deeply. Furthermore, research on the relationship between production risk, price risk, and income risk, as well as the development of specific risk management tools and resources, can assist Vannamei shrimp farmers in enhancing their financial resilience and operational sustainability. Thus, future research is expected to provide a better understanding of the risks associated with Vannamei shrimp farming and effective risk management strategies to address them.

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